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FLOOD INSURANCE STUDY

VILLAGE OF BROOKLYN HEIGHTS, OHIO

CUYAHOGA COUNTY

DECEMBER 15, 1980

federal emergency management agency
federal insurance administration

COMMUNITY NUMBER - 390101

FEM I. 209:

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PUBLISHED SEPARATELY:

Flood Insurance Rate Map

FLOOD INSURANCE STUDY

VILLAGE OF BROOKLYN HEIGHTS,
CUYAHOGA COUNTY, OHIO

1.0 INTRODUCTION

1.1 Purpose of Study

This Flood Insurance Study investigates the existence and severity of flood hazards in the Village of Brooklyn Heights, Cuyahoga County, Ohio, and aids in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. This study will be used to convert the Village of Brooklyn Heights to the regular program of flood insurance by the Federal Insurance Administration (FIA). Local and regional planners will use this study in their efforts to promote sound flood plain management.

In some states or communities, flood plain management criteria or regulations may exist that are more restrictive or comprehensive than those on which these Federally-supported studies are based. These criteria take precedence over the minimum Federal criteria for purposes of regulating development in the flood plain, as set forth in the Code of Federal Regulations at 44 CFR, 60.1 (d). In such cases, however, it shall be understood that the state (or other jurisdictional agency) shall be able to explain these requirements and criteria.

1.2 Authority and Acknowledgements

The source of authority for this Flood Insurance Study is the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973.

The hydrologic and hydraulic analyses for this study were performed by Burgess & Niple, Limited for the Federal Insurance Administration, under Contract No. H-4717. Approximate flood boundaries for all streams in the Village of Brooklyn Heights were initially determined in February 1974 and revised in April 1976 by Gannett, Fleming, Corddry, and Carpenter under contract to the Federal Insurance Administration. This study was completed in February 1980.

1.3 Coordination

The Consultation Coordination Officer appointed by the FIA organized the first community meeting held on March 22, 1978. This meeting, attended by representatives of the Village of Brooklyn Heights, the FIA, the Study Contractor, and the Ohio Department of Natural Resources (ODNR), was held to explain the nature and purpose of the Flood Insurance Study. Upon the initiation of the study, a news release was placed in the Cleveland Plain

Dealer on May 17, 1979 and the Brooklyn Heights Breeze on June 6, 1979, to state the study objectives and to notify all interested persons to submit any relevant facts and technical data concerning local flood hazards.

Results of the hydrologic analyses were coordinated with the Village of Brooklyn Heights; the U.S. Geological Survey (USGS); the U.S. Department of Agriculture, Soil Conservation Service (SCS); the Buffalo District, U.S. Army Corps of Engineers (COE); and the ODNR. The ODNR served as the State Coordinating Agency for this study.

An intermediate meeting was held at Brooklyn Heights on February 15, 1980. The purpose of this meeting was to review this Flood Insurance Study's floodway boundaries as prepared by the Study Contractor with the City Engineer of Brooklyn Heights. Modification of West Creek's channel and flood area were made due to the recent industrial park development in the flood plain. No other changes were made as a result of this meeting.

Subsequent to the intermediate meeting, a flood study for West Creek near the I-480 and I-77 interchange was made available. This study developed 100-year depths for West Creek and was more detailed than the approximate methods originally utilized by the Study Contractor. The study was found to be acceptable and was therefore used to delineate the 100-year flood boundary in the vicinity of the I-480 and I-77 interchange.

On July 31, 1980, the results of the work by the Study Contractor were reviewed and accepted at a final coordination meeting attended by representatives of the Study Contractor, the FIA, and the ODNR, and community officials.

2.0 AREA STUDIED

2.1 Scope of Study

This Flood Insurance Study covers the incorporated area of the Village of Brooklyn Heights. The area of study is shown on the Vicinity Map (Figure 1).

The areas studied by detailed methods were selected with priority given to all known flood hazard areas, and areas of projected development or proposed construction for the next five years, through February 1985.

Approximate methods of analysis were used to study those areas having a low development potential or minimal flood hazards. The scope and methods of study were proposed to and agreed upon by the FIA and the Village of Brooklyn Heights.

Floods caused by overflow of the Cuyahoga River within the corporate limits were studied in detail. Flooding on West Creek and Tributary No. 1 of West Creek were studied by approximate methods.

2.2 Community Description

The Village of Brooklyn Heights is located along the west bank of the Cuyahoga River in central Cuyahoga County, Ohio. A suburb of Cleveland, Brooklyn Heights covers approximately 1.84 square miles and is bordered by Cleveland to the north and west, Parma to the west, Seven Hills to the

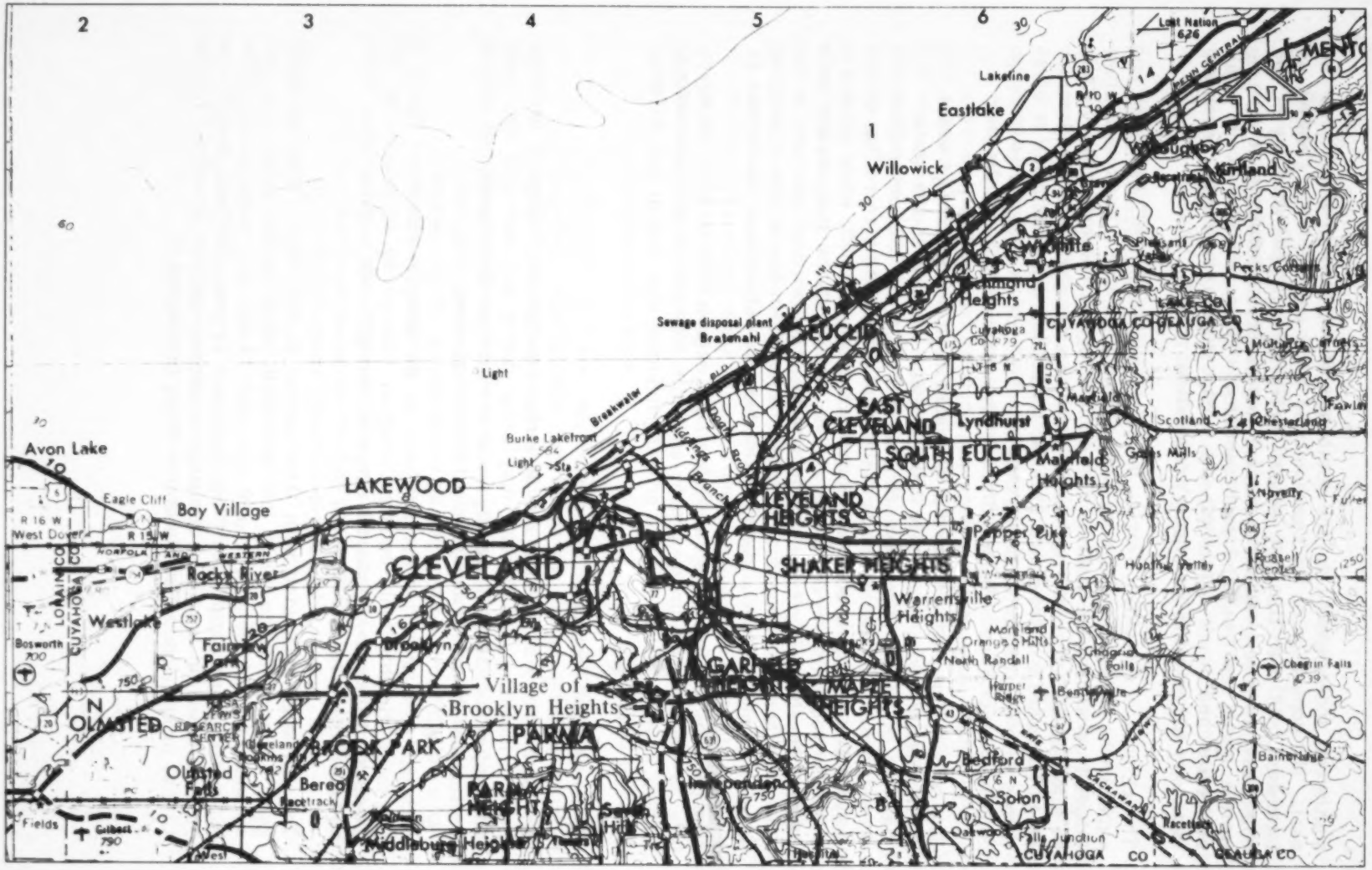

FIGURE 1

FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration

VILLAGE OF BROOKLYN HEIGHTS, OH
(CUYAHOGA CO.)

APPROXIMATE SCALE
4 0 4 8 12 MILES

VICINITY MAP

southwest, Independence to the southeast, and Cuyahoga Heights to the east. The population of the community is 1,527 persons (1970 Census), an increase of 78 over the 1960 census (Reference 1). The economy of the community is closely related to the existing industrial development existing in the north, central, and east sections. There are also some small businesses and retail establishments along with a residential economy necessary to house the community's population.

The climate of Brooklyn Heights is mainly continental in character, but experiences strong modifying influences from Lake Erie. The temperature ranges from an average monthly high of 71.4 degrees Fahrenheit (F.) in July to a low of 26.9 degrees F. in January, with an average yearly temperature of 49.7 degrees F. (Reference 2). The mean annual precipitation is 34.99 inches with an average recorded snowfall of 46 inches per year (Reference 3). The precipitation is fairly uniformly distributed throughout the year.

The soils in this region formed in glacial drift of Wisconsin age which was derived mainly from sandstone, shale, and low amounts of limestone. The majority of soils in Brooklyn Heights fall into the Mahoning-Ellsworth Association. This association occupies gently undulating to rolling upland areas. The Mahoning soils are somewhat poorly drained, while Ellsworth soils are moderately well-drained. In the vicinity of the steep valley walls of the Cuyahoga River and its tributaries, the existing soils are in the Geeburg-Glenford Association. These soils were formed in alternating layers of limey clay and silt, and are moderately well-drained (Reference 4).

The predominant forest vegetation is of the oak-hickory variety. However, due to the variation in topography and soils, those areas left undeveloped exhibit a wider variety of plant growth, including elm, beech, and different types of maple.

2.3 Principal Flood Problems

The past history of flooding on the streams within the Village of Brooklyn Heights indicates that flooding may occur during any season of the year. The majority of floods generally occur in winter or early spring and may be worsened if the rain is accompanied by melting snow.

Although no information was available on the specific effects of floods in Cuyahoga Heights and Brooklyn Heights, damage to structures in the Cuyahoga River flood plain has occurred during floods in 1954, 1959, 1969, and most recently in 1976.

The discharge associated with these events at the USGS Cuyahoga River gage at Independence, Ohio (no. 04208000) were 14,200 cubic feet per second (cfs), 24,800 cfs, 13,600 cfs, and 14,050 cfs, respectively. The estimated return periods for these floods are 10-year, 100-year, 9-year, and 10-year based on the flood discharge-frequency analysis developed for the City of Independence Flood Insurance Study (Reference 5).

2.4 Flood Protection Measures

The Village of Brooklyn Heights has no local flood protection measures. Nonstructural measures of flood protection are being utilized to aid in the prevention of future flood damage. These are in the form of land use regulations adopted from the Code of Federal Regulations which control building within areas that have a high risk of flooding.

3.0 ENGINEERING METHODS

For the flooding sources studied in detail in the community, standard hydrologic and hydraulic study methods were used to determine the flood hazard data required for this study. Flood events of a magnitude which are expected to be equalled or exceeded once on the average during any 10-, 50-, 100-, or 500-year period (recurrence interval) have been selected as having special significance for flood plain management and for flood insurance premium rates. These events, commonly termed the 10-, 50-, 100-, and 500-year floods, have a 10, 2, 1, and 0.2 percent chance, respectively, of being equalled or exceeded during any year. Although the recurrence interval represents the long term average period between floods of a specific magnitude, rare floods could occur at short intervals or even within the same year. The risk of experiencing a rare flood increases when periods greater than one year are considered. For example, the risk of having a flood which equals or exceeds the 100-year flood (one percent chance of annual occurrence) in any 50-year period is about 40 percent (four in ten), and for any 90-year period, the risk increases to about 60 percent (six in ten). The analyses reported here reflect flooding potentials based on conditions existing in the community at the time of completion of this study. Maps and flood elevations will be amended periodically to reflect future changes.

3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish the peak discharge-frequency relationships for floods of the selected recurrence intervals for the flooding source studied in detail affecting the community.

Discharge-frequency relationships have been developed on the Cuyahoga River just upstream of the detailed study reach using streamflow data recorded at the Independence gaging station (No. 0420800 with 49 years of record through 1977).

The 10-, 50-, 100-, and 500-year frequency flows were previously calculated for the Flood Insurance Studies prepared for the City of Cleveland and the City of Independence (References 6 and 5).

Since the study reach of the Cuyahoga River in Brooklyn Heights lies directly between the reaches studied in the Cleveland and Independence Flood Insurance Studies, the discharge-frequency relationships developed for these studies were adopted for use in the Brooklyn Heights study.

Peak discharges for the 10-, 50-, 100-, and 500-year floods of the flooding source studied in detail in the community are shown in Table 1.

TABLE 1 - SUMMARY OF DISCHARGES

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (SQ MILES)	PEAK DISCHARGE (CFS) 10-YEAR	50-YEAR	100-YEAR	500-YEAR
CUYAHOGA RIVER Below West Creek	745	15,150	20,400	23,000	29,200

3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of the streams in the community were carried out to provide estimates of the elevations of the floods of the selected recurrence intervals along the flooding source studied in detail.

Cross sections for the backwater analyses of the Cuyahoga River were obtained from orthophoto topographic maps with two-foot contour intervals at a scale of 1:2400 (Reference 7) and the City of Cleveland and the City of Independence Flood Insurance Studies (References 6 and 5). The below-water sections were obtained by field measurements.

Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles (Exhibit 1). For stream segments for which a floodway was computed (Section 4.2), selected cross section locations are also shown on the Flood Boundary and Floodway Map (Exhibit 2).

Channel roughness factors (Manning's "n") used in the hydraulic computations were initially chosen by engineering judgment and based on field observations of the streams and flood plain areas. The roughness value for the main channel of the Cuyahoga River was 0.03, with the flood plain roughness value being 0.05. The resulting flood profiles matched those from the Independence Flood Insurance Study (Reference 5) at the upper end of the study reach.

Starting water-surface elevations for the Cuyahoga River were taken from the City of Cleveland Flood Insurance Study (Reference 6). Water-surface elevations of floods of the selected recurrence intervals were computed through use of the COE HEC-2 step-backwater computer program (Reference 8). Flood profiles were drawn showing computed water-surface elevations to an accuracy of 0.5 foot for floods of the selected recurrence intervals.

The hydraulic analyses for this study are based only on the effects of unobstructed flow. The flood elevations as shown on the profiles are, therefore, considered valid only if hydraulic structures, in general, remain unobstructed and if channel and overbank conditions remain essentially the same as ascertained during this study.

All elevations are referenced from National Geodetic Vertical Datum of 1929 (NGVD); elevation reference marks used in the study are shown on the maps.

4.0 FLOOD PLAIN MANAGEMENT APPLICATIONS

The National Flood Insurance Program encourages state and local governments to adopt sound flood plain management programs. Therefore, each Flood Insurance Study includes a flood boundary map designed to assist communities in developing sound flood plain management measures.

4.1 Flood Boundaries

In order to provide a national standard without regional discrimination, the 100-year flood has been adopted by the FIA as the base flood for purposes of flood plain management measures. The 500-year flood is employed to indicate additional areas of flood risk in the community. For each stream studied in detail, the boundaries of the 100-year and the 500-year floods have been delineated using the elevations determined at each cross section; between cross sections the boundaries were interpolated using topographic maps at a scale of 1:2400, with a contour interval of two feet (Reference 7).

For the streams studied by approximate methods, the boundary of the 100-year flood was developed from the Flood Hazard Boundary Map (Reference 9) and the topographic maps referenced above.

The boundaries of the 100- and 500-year floods are shown on the Flood Boundary and Floodway Map (Exhibit 2). Small areas within the flood boundaries may lie above the flood elevations and, therefore, not be subject to flooding; owing to lack of detailed topographical information or to limitations of the map scale, such areas are not shown. In cases where the 100-year and the 500-year flood boundaries are close together, only the 100-year boundary has been shown.

4.2 Floodways

Encroachment on flood plains, such as artificial fill, reduces the flood-carrying capacity, increases the flood heights of streams, and increases flood hazards in areas beyond the encroachment itself. One aspect of flood plain management involves balancing the economic gain from flood plain

development against the resulting increase in flood hazard. For purposes of the National Flood Insurance Program, the concept of a floodway is used as a tool to assist local communities in this aspect of flood plain management. Under this concept, the area of the 100-year flood is divided into a floodway and a floodway fringe. The floodway is the channel of a stream plus any adjacent flood plain areas that must be kept free of encroachment in order that the 100-year flood may be carried without substantial increases in flood heights. Minimum standards of the FIA limit such increases in flood heights to 1.0 foot, provided that hazardous velocities are not produced.

The floodways presented in this study were initially computed on the basis of equal conveyance reduction from each side of the flood plain. The final floodways presented in this study reflect any adjustments made to smooth out the initial encroachment limits. The results of these computations were tabulated at selected cross sections for each stream segment for which a floodway was computed (Table 2). Portions of the floodway lie outside the corporate limits.

As shown on the Flood Boundary and Floodway Map (Exhibit 2), the floodway boundaries were determined at cross sections; between cross sections, the boundaries were interpolated. In cases where the boundaries of the floodway and the 100-year flood are either close together or collinear, only the floodway boundary has been shown.

The area between the floodway and the boundary of the 100-year flood is termed the floodway fringe. The floodway fringe thus encompasses the portion of the flood plain that could be completely obstructed without increasing the water-surface elevation of the 100-year flood more than 1.0 foot at any point. Typical relationships between the floodway and the floodway fringe and their significance to flood plain development are shown in Figure 2.

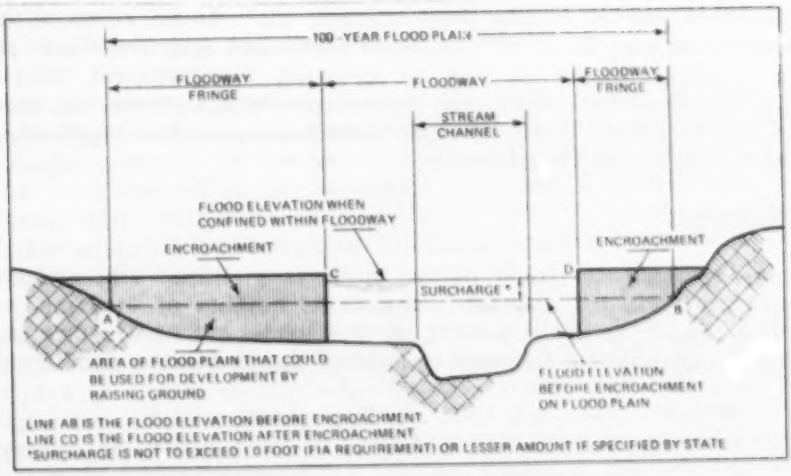
100-YEAR FLOOD PLAIN
FLOODWAY FRINGE
FLOODWAY
FLOODWAY FRINGE
STREAM CHANNEL
FLOOD ELEVATION WHEN CONFINED WITHIN FLOODWAY
ENCROACHMENT
ENCROACHMENT
C
D
SURCHARGE *
A
B
AREA OF FLOOD PLAIN THAT COULD BE USED FOR DEVELOPMENT BY RAISING GROUND
FLOOD ELEVATION BEFORE ENCROACHMENT ON FLOOD PLAIN
LINE AB IS THE FLOOD ELEVATION BEFORE ENCROACHMENT
LINE CD IS THE FLOOD ELEVATION AFTER ENCROACHMENT
*SURCHARGE IS NOT TO EXCEED 1.0 FOOT (FIA REQUIREMENT) OR LESSER AMOUNT IF SPECIFIED BY STATE

FIGURE 2 - Floodway Schematic

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION		
CROSS SECTION	DISTANCE[1]	WIDTH[2] (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET/SEC.)	WITH FLOODWAY (NGVD)	WITHOUT FLOODWAY (NGVD)	DIFFERENCE
CUYAHOGA RIVER							
A	700	266	4285	5.4	597.5	596.5	1.0
B	1700	561	5140	4.5	597.6	596.6	1.0
C	3810	147	2922	8.0	597.7	596.7	1.0
D	4947	190	3833	6.1	598.3	597.3	1.0
E	6191	250	3604	6.5	598.4	597.4	1.0
F	7291	355	4876	4.8	598.5	597.5	1.0
G	8491	300	3826	5.8	598.6	597.6	1.0

[1]FEET ABOVE CORPORATE LIMITS
[2]THIS WIDTH EXTENDS BEYOND CORPORATE LIMITS

TABLE 2

FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration

VILLAGE OF BROOKLYN HEIGHTS, OH
(CUYAHOGA CO.)

FLOODWAY DATA

CUYAHOGA RIVER

The floodways in this report are recommended to local agencies as minimum standards that can be adopted or that can be used as a basis for additional studies.

5.0 INSURANCE APPLICATION

In order to establish actuarial insurance rates, the FIA has developed a process to transform the data from the engineering study into flood insurance criteria. This process includes the determination of reaches, Flood Hazard Factors (FHF), and flood insurance zone designations for each flooding source affecting the Village of Brooklyn Heights.

5.1 Reach Determinations

Reaches are defined as lengths of watercourses having relatively the same flood hazard, based on the average weighted difference in water-surface elevations between the 10- and 100-year floods. This difference does not have a variation greater than that indicated in the following table for more than 20 percent of the reach.

Average Difference Between 10- and 100-year Floods	Variation
Less than 2 feet	0.5 foot
2 to 7 feet	1.0 foot
7.1 to 12 feet	2.0 feet
More than 12 feet	3.0 feet

The locations of the reaches determined for the Village of Brooklyn Heights are shown on the Flood Profiles (Exhibit 1) and are summarized in the Flood Insurance Zone Data Table (Table 3).

5.2 Flood Hazard Factors

The FHF is used to correlate flood information with insurance rate tables. Correlations between property damage from floods and their FHFs are used to set actuarial insurance premium rate tables based on FHFs from 005 to 200.

The FHF for a reach is the average weighted difference between the 10- and 100-year flood water-surface elevations expressed to the nearest 0.5 foot, and shown as a three-digit code. For example, if the difference between water-surface elevations of the 10- and 100-year floods is 0.7 foot, the FHF is 005; if the difference is 1.4 feet, the FHF is 015; if the difference is 5.0 feet, the FHF is 050. When the difference between the 10- and 100-year water-surface elevations is greater than 10.0 feet, accuracy for the FHF is to the nearest foot.

5.3 Flood Insurance Zones

After the determination of reaches and their respective FHFs, the entire incorporated area of the Village of Brooklyn Heights was divided into zones, each having a specific flood potential or hazard. Each zone was assigned one of the following flood insurance zone designations:

Zone A:	Special Flood Hazard Areas inundated by the 100-year flood, determined by approximate methods; no base flood elevations are shown or FHFs determined.
Zone A8:	Special Flood Hazard Areas inundated by the 100-year flood, determined by detailed methods; base flood elevations are shown, and zones subdivided according to FHF.
Zone B:	Areas between the Special Flood Hazard Area and the limits of the 500-year flood, including areas of the 500-year flood plain that are protected from the 100-year flood by dike, levee, or other water control structure; or areas subject to certain types of 100-year shallow flooding where depths are less than 1.0 foot; and areas subject to 100-year flooding from sources with drainage areas less than 1 square mile. Zone B is not subdivided.
Zone C:	Areas of minimal flooding.

Table 3, "Flood Insurance Zone Data," summarizes the flood elevation differences, FHFs, flood insurance zones, and base flood elevations for the flooding source studied in detail in the community.

5.4 Flood Insurance Rate Map Description

The Flood Insurance Rate Map for the Village of Brooklyn Heights is, for insurance purposes, the principal result of the Flood Insurance Study. This map (published separately) contains the official delineation of flood insurance zones and base flood elevation lines. Base flood elevation lines show the locations of the expected whole-foot water-surface elevations of the base (100-year) flood. This map is developed in accordance with the latest flood insurance map preparation guidelines published by the FIA.

FLOODING SOURCE	PANEL[1]	ELEVATION DIFFERENCE[2] BETWEEN 1.0% (100-YEAR) FLOOD AND			FLOOD HAZARD FACTOR	ZONE	BASE FLOOD ELEVATION[3] (NGVD)
		10% (10-YEAR)	2% (50-YEAR)	0.2% (500-YEAR)			
CUYAHOGA RIVER REACH 1	0001	–4.2	–1.1	2.2	040	A8	VARIES–SEE MAP

[1]FLOOD INSURANCE RATE MAP PANEL
[2]WEIGHTED AVERAGE
[3]ROUNDED TO NEAREST FOOT

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration

VILLAGE OF BROOKLYN HEIGHTS, OH
(CUYAHOGA CO.)

FLOOD INSURANCE ZONE DATA

CUYAHOGA RIVER

6.0 OTHER STUDIES

This study has been prepared concurrently with Flood Insurance Studies prepared for the City of Parma and the Village of Cuyahoga Heights (References 10 and 11). It has also been coordinated with studies for the City of Cleveland, the City of Seven Hills, and the City of Independence (References 6, 12, and 5).

A Flood Hazard Boundary Map has been published by the Federal Insurance Administration (Reference 9). The differences between the Flood Hazard Boundary Map and this study are justified due to the more detailed nature of this Flood Insurance Study.

This report either supersedes or is compatible with all previous studies published on streams studied in this report and should be considered authoritative for the purposes of the National Flood Insurance Program.

7.0 LOCATION OF DATA

Survey, hydrologic, hydraulic and other pertinent data used in this study can be obtained by contacting the Insurance and Mitigation Division, Federal Emergency Management Agency, One North Dearborn Street, Chicago, Illinois 60602.

8.0 REFERENCES AND BIBLIOGRAPHY

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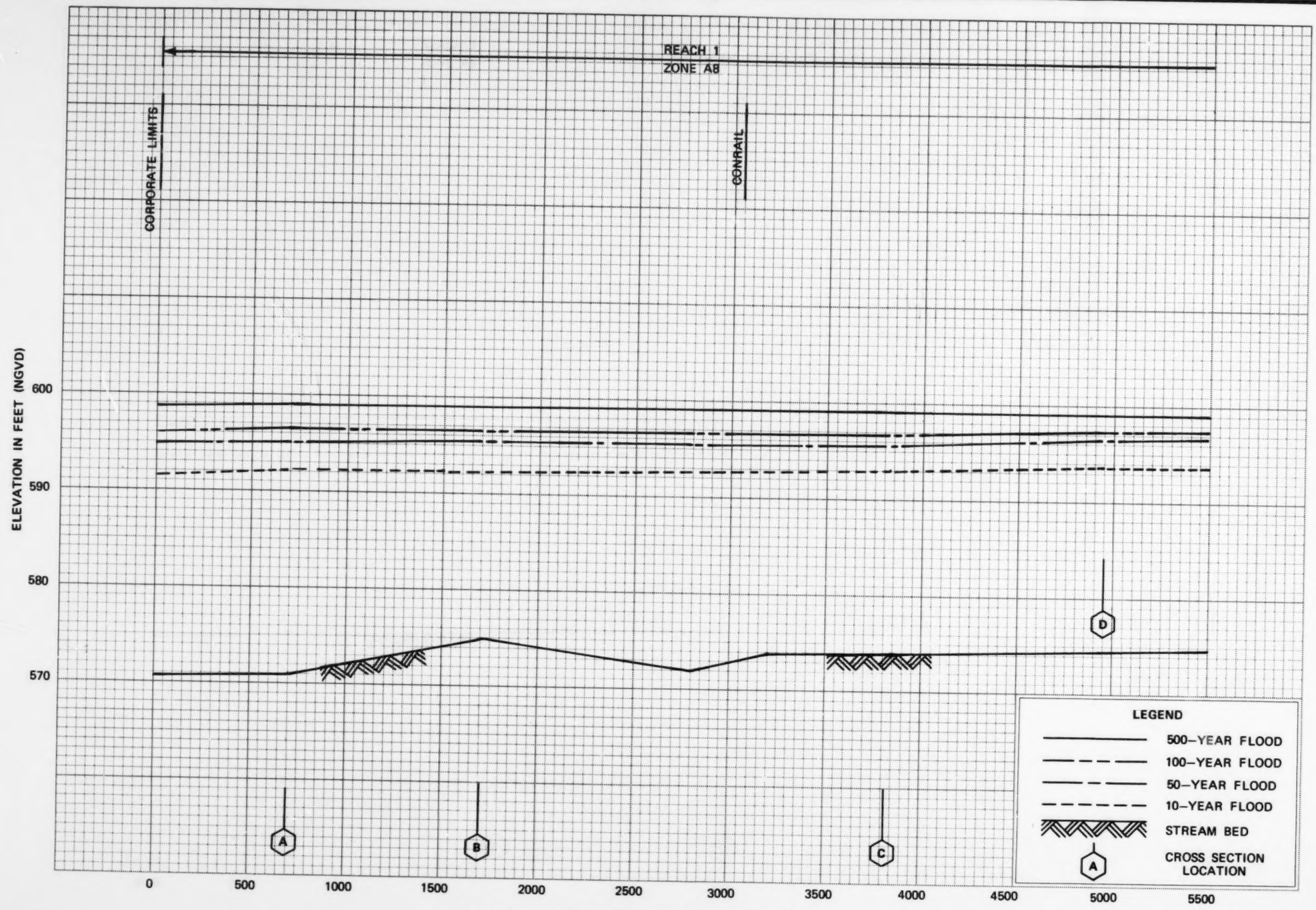


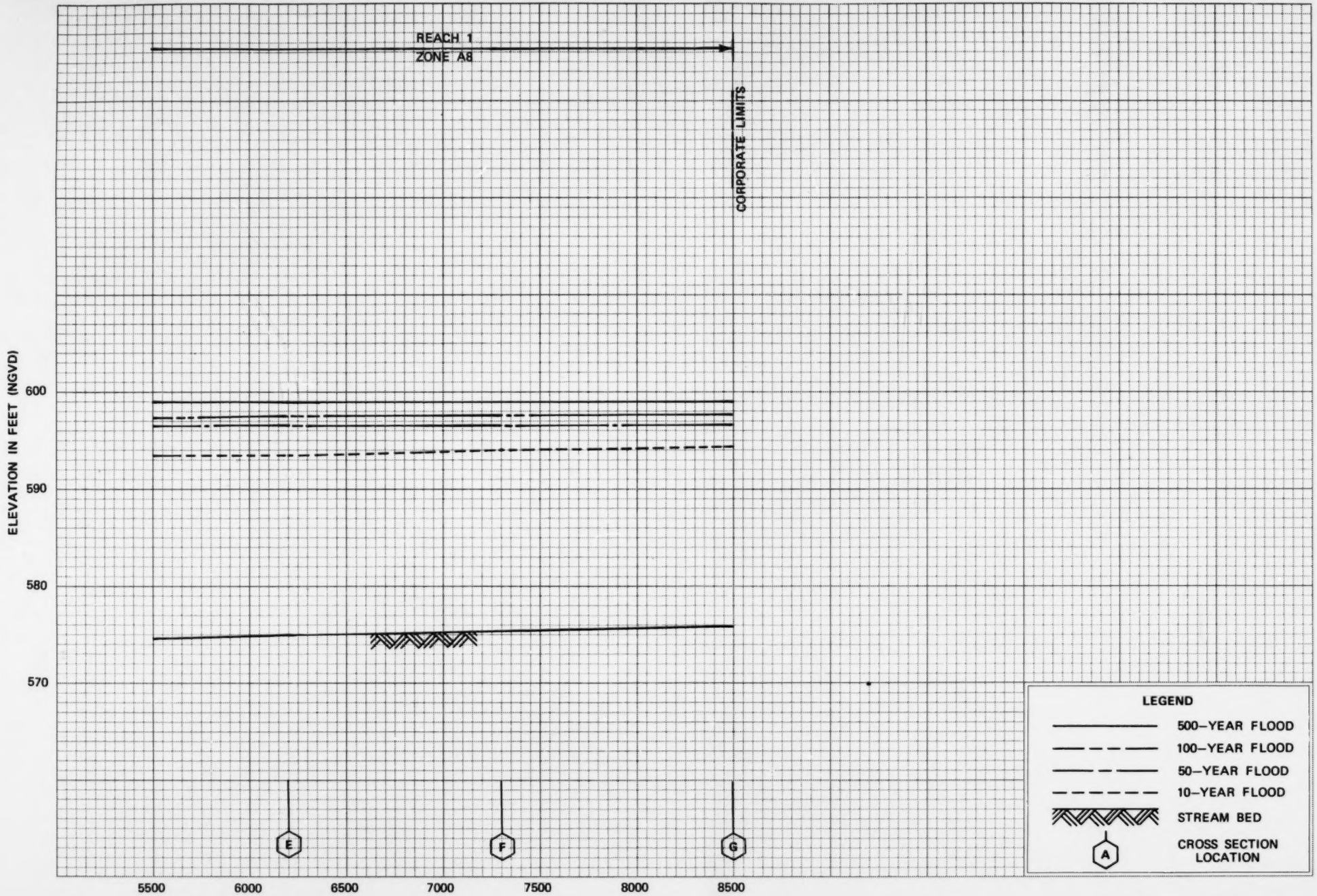
FLOOD PROFILES

CUYAHOGA RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration

VILLAGE OF BROOKLYN HEIGHTS, OH
(CUYAHOGA CO.)

01P



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FLOOD PROFILES

CUYAHOGA RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration

VILLAGE OF BROOKLYN HEIGHTS, OH
(CUYAHOGA CO.)

02P